CONTRIBUTIONS TO A KNOWLEDGE OF AUSTRALIAN FORAMINIFERA. Part II.

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(Continued from Proceedings, 1904, p. 831.)

(Plate vi.)

This paper might be taken as an addition to the work published by one or other of us in the Records of the Australian Museum, Vol. vi., Pt. 4, or in the Proceedings of the Linnean Society of New South Wales, 1904, p.810.

The recent foraminiferal sands examined have been obtained from dredgings made by Mr. C. Hedley, F.L.S., of the Australian Museum. The fossil material has kindly been supplied by Miss Mary Lodder, Launceston Museum, Tasmania.

The materials recorded in this and our previous papers having been obtained from localities on and about the Australian coasts far removed from one another, have enabled us to make deductions regarding the distribution of Foraminifera in Australian waters, and also in connection with the conditions of climate and deposition at the time of the laying down of the Table Cape Beds.

1. *Foraminiferal sands from Van Diemen's Inlet, Gulf of Carpentaria; muddy bottom; depth 2 fathoms.*

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Biloculina irregularis d'Orb.; diminutive.
2. Spiroloculina limbata d'Orb.; diminutive.
3. S. arenaria Brady.
4. Miliolina seminulum Linn ; diminutive.

5. M. ALVEOLINIFORMIS Brady; diminutive.
6. M. RETICULATA d'Orb.
7. M. CIRCULARIS Bornem; diminutive.
8. M. UNDOSA Karrer.

Subfamily **HAUERININÆ**.

9. OPHTHALMIDIUM INCONSTANS Brady.
10. PLANISPIRINA EXIGUA Brady.
11. P. CELATA Costa.
12. P. (SIGMOILINA) SIGMOIDEA Brady.

Subfamily **PENEROPLIDININÆ**.

13. ORBITOLITES sp.; fragments.

Family LITUOLIDÆ.

Subfamily **TROCHAMMININÆ**.

14. TROCHAMMINA RINGENS Brady.
15. WEBBINA CLAVATA P. & J.

Subfamily **LITUOLINÆ**.

16. HAPLOPHRAGMIUM FONTINENSE Terq.

Family TEXTULARIIDÆ.

Subfamily **TEXTULARIINÆ**.

17. TEXTULARIA CONCAVA Karrer.
18. T. GRAMEN d'Orb.
19. VERNEUILINA SPINULOSA Reuss.
20. CLAVULINA CYLINDRICA Hantk.
21. SPIROPLECTA AMERICANA Ehrenb.

Subfamily **BULIMININÆ**.

22. BOLIVINA COSTATA d'Orb.
23. B. TEXTULARIOIDES Reuss.
24. BULIMINA INFLATA Seg.
25. VIRGULINA SUBSQUAMOSA Egger.

Family CHEILOSTOMELLIDÆ.

26. Cheilostomella ovoidea Reuss.

Family LAGENIDÆ.

Subfamily **LAGENINÆ.**

27. Lagena aspera Reuss.
28. L. acuticostata Reuss.
29. L. desmophora Ry. Jones (nonapiculate variety).
30. L. hispida Reuss.
31. L. orbignyana Seg.

Subfamily **NODOSARIINÆ.**

32. Nodosaria scalaris Batsch, var. separans Brady.
33. Cristellaria vortex F. & M.

Subfamily **POLYMORPHININÆ.**

34. Polymorphina elegantissima P. & J.
35. Uvigerina pygmæa d'Orb.
36. U. interrupta Brady.
37. U. canariensis d'Orb.
38. U. schwageri Brady.

Family GLOBIGERINIDÆ.

39. Globigerina bulloides d'Orb.
40. G. bulloides var. triloba Reuss.
41. G. cretacea d'Orb.
42. G. æquilateralis Brady.
43. G. conglobata Brady.
44. G. dubia Egger.
45. G. digitata Brady.
46. Orbulina universa d'Orb.

Family ROTALIIDÆ.

Subfamily **ROTALIINÆ.**

47. Discorbina biconcava P. & J.
48. D. parisiensis d'Orb.

49. D. araucana d'Orb.
50. Truncatulina haidingerii d'Orb.
51. T. ungeriana d'Orb.
52. Anomalina ariminensis d'Orb.
53. Pulvinulina auricula F. & M.
54. P. menardii d'Orb.
55. P. patagonica d'Orb.
56. P. canariensis d'Orb.
57. Rotalia clathrata Brady.
58. R. papillosa Brady.
59. Carpenteria proteiformis Goës.
60. Rupertia stabilis Wallich.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

61. Nonionina scapha F. & M.
62. Polystomella macella F. & M.

Subfamily NUMMULITINÆ.

63. Amphistegina lessonii d'Orb.

New Species and Varieties.

Textularia quadrilatera (?) Schwager, var.
(Plate vi. fig. 1).

The test is almost hyaline, approaching that of Buliminiuæ in appearance, faintly brownish in tinge from foreign material. It is larger than the types described in the Challenger Reports; the proximal end is rounded, and therefore does not agree in this respect with Schwager's type-form, which is acutely pointed. The distal end containing the aperture is missing.

The test is very flat and remarkable for its straight contour, reminding one of the appearance of a pteropod shell; it has a thickened rim of hyaline supplemental skeleton.

CRISTELLARIA VARIABILIS Reuss, var. ALLOMORPHINOIDES, var.nov.
(Plate vi. fig.2).

This is a minute hyaline shell, the last chamber of which envelops the earlier chambers and is shaped like *Lagena orbignyana*, but has a cristellarian aperture. The enclosed earlier chambers have an arrangement which reminds one of that of the internal chambers of *Allomorphina trigonula*, but they open into one another by cristellarian necks. In section the shell is rather flattened. Size: length 0·35, breadth 0·25 mm.

Note.—The figure represents the shell seen by transmitted light.

Remarks.—About 20 % of this material is made up of foraminifera, the remaining portion consisting of sand, shell-fragments, one or two species of ostracod shells, polyzoa, and spicules of sponges, echinoderms and alcyonarian corals. A few pteropod shells are also present.

The members of the family Miliolidæ are not well represented in numbers, and are uniformly diminutive in size. This is to be attributed to the fact that the material was dredged in muddy and very shallow water, whereas members of the family thrive best in clear water at a depth of from 50 to 150 fathoms. The great amount of fresh water brought down by rivers to the Gulf also brings about conditions unfavourable to the perfect development of the Miliolidæ.

Members of the family Textulariidæ are extremely abundant as regards numbers of individuals, but are limited to comparatively few species and those of a small size. The forms present are such as are not restricted to great depths, and, like *Textularia gramen* and *Bolivina costata*, usually found in shallow waters. Yet all these species belong to deeper water than they were found in. To this and to the abundance of brackish water we may attribute the minuteness of the forms obtained.

The Globigerinidæ are extremely abundant. This is very remarkable, as this family is pelagic, and properly speaking, belongs to deeper waters. The species represented are, however, all micromorphs.

The Lagenidæ are represented chiefly by species of *Uvigerina*. According to Carpenter this genus belongs, properly speaking, to depths between 100 and 300 fathoms. All the forms present are micromorphs. The genus *Lagena* is very poorly represented as regards number of individuals. This is to be expected, as the genus flourishes best at depths of 50 fathoms. The species present here are delicate, unstriated and nonapiculate.

The Rotaliidæ are well represented, comparatively speaking, both as regards species and numbers. The occurrence of specimens of *Rotalia clathrata* is interesting, as verifying Carpenter's remarks regarding the adaptability of the genus *Rotalia* to estuarine conditions. Although the water is shallow, the genus *Discorbina* is represented by minute forms only.

Nothing is more noticeable in an examination of this sand than that the foraminifera in it are characteristic of deeper water than that in which they occur, and show a marked tendency towards diminution in size. We would suggest, as a likely explanation of this, that the Gulf of Carpentaria is a remnant of a larger Tertiary sea, the floor of which has been undergoing elevation, eliminating the weaker oceanic forms and reducing the size of the hardier ones.

The absence of forms like *Tinoporus* and *Calcarina*, and the rarity of *Amphistegina* and *Orbitolites* might at first sight be taken as evidence that the forms present do not represent a true, stationary, littoral fauna; but this feature might also be explained on the grounds of brackish and muddy conditions.

A glance at the geological map of Queensland shows the Gulf to be surrounded by late Tertiary and alluvial strata.

2. *Foraminifera dredged at a depth of 15 fathoms off Palm Island near Townsville, Q., by C. Hedley.*

The coarser sands from this locality were examined by one of us (H. I. J.) in 1903, and a list of forms present was published in the Proceedings of this Society for 1904. The eighteen species already recorded are omitted in this list, which comprises the

finer dredgings, except a few which are very abundant in the fine as well as coarse sands.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Miliolina reticulata d'Orb.
2. M. seminulum Linn.
3. M. valvularis Reuss.
4. M. linnæana d'Orb.
5. M. scrobiculata Brady.
6. Spiroloculina tenuiseptata Brady.
7. S. tenuis Czjzek.
8. S. limbata d'Orb.
9. S. crenata Karrer.
10. S. asperula Karrer.
11. S. grata Terq.
12. S. excavata d'Orb.
13. S. tortuosa Chapman (Journ. Linn. Soc. Zool. Vol. xxviii. p.171, pl.19, fig.5).

Subfamily HAUERININÆ.

14. Planispirina exigua Brady.
15. Ophthalmidium cornu Chapman (Journ. Linn. Soc. Zool. Vol.xxviii. p.408, pl.36, fig.6).
16. O. inconstans Brady.

Subfamily PENEROPLIDINÆ.

17. Orbitolites complanata Lamk.
18. Articulina chapmani, sp.n. (Plate vi., figs.5*a*, *b*).

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

19. Placopsilina cenomana d'Orb.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

20. Textularia trochus d'Orb.
21. T. concava Karrer.

22. T. SAGITTULA Defr.
23. VERNEUILINA PROPINQUA Brady.
24. V. SPINULOSA Reuss.
25. V. VARIABILIS Brady
26. GAUDRYINA PUPOIDES d'Orb.
27. CLAVULINA ANGULARIS d'Orb.

Subfamily **BULIMININÆ.**

28. BOLIVINA TEXTULARIOIDES Reuss.
29. B. PUNCTATA d'Orb.
30. B. TORTUOSA Brady.

Subfamily **CASSIDULININÆ.**

31. EHRENBERGINA SERRATA Reuss.

Family LAGENIDÆ.

Subfamily **LAGENINÆ.**

32. LAGENA STRIATA (apiculate variety) d'Orb.
33. L. GRACILLIMA Seg. (one specimen only).

Subfamily **POLYMORPHININÆ.**

34. UVIGERINA INTERRUPTA Brady.
35. SAGRINA AUSTRALIENSIS, sp.n. (Plate vi., figs. 3*a*, *b*).

Subfamily **RAMULININÆ.**

36. RAMULINA GLOBULIFERA Brady.

Family GLOBIGERINIDÆ.

37. GLOBIGERINA LINNÆANA d'Orb.
38. G. BULLOIDES d'Orb.

Family ROTALIDÆ.

Subfamily **SPIRILLININÆ.**

39. SPIRILLINA DECORATA.

Subfamily **ROTALIINÆ.**

40. DISCORBINA ARAUCANA d'Orb.
41. D. TURBO d'Orb.

42. D. PATELLIFORMIS Brady.
43. D. OPERCULARIS d'Orb.
44. TRUNCATULINA UNGERIANA d'Orb.
45. T. PRÆCINCTA Karrer.
46. ANOMALINA FOVEOLATA Brady.
47. A. POLYMORPHA Costa.
48. A. ARIMINENSIS d'Orb.
49. PULVINULINA CANARIENSIS d'Orb.
50. P. OBLONGA Williamson.
51. P. OBLONGA var. SCABRA Brady.
52. P. TUMIDA Brady.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

53. NONIONINA BOUEANA d'Orb.
54. POLYSTOMELLA HEDLEYI Jensen.
55. P. VERRICULATA Brady.

Subfamily NUMMULITINÆ.

56. OPERCULINA AMMONOIDES Gron.

SAGRINA AUSTRALIENSIS, n.sp. (Plate vi. figs.3*a*, *b*, *c*).

This species has a uvigerine commencement, after which it consists of a uniserial row of oval chambers cylindrical in section. The character of the shell is intermediate between *S. dimorpha* and *S. virgula*. The shell is thick, and studded with large pits as in *S. dimorpha*. There are also tubercles externally approximating to the spines of *S. virgula*. The neck is as in *S. virgula*.

There is a distinct constriction at the junction of the chambers, and some of the chambers are produced outwards into small monticular prominences (see fig.3*a*). The chambers increase gradually in size.

Under a high power the surface appears as in fig.3*b*. On focussing down, canals are seen in the walls, extending from the interior and opening to the exterior in the small tubercles.

Size: length 0·7 mm.

This species is fairly common in the Palm Island dredgings.

ARTICULINA CHAPMANI n.sp. (Plate vi. figs.5*a*, *b*).

This is a highly ornamented species. It consists of a series of chambers, slowly increasing in size, and ending in a smaller neck-like spherical chamber with a round terminal aperture. Unfortunately in the two specimens found the proximal extremity was broken off.

The test is distinctly porcellanous. Because of this characteristic, as well as on account of the nodosarine arrangement of the chambers and their high ornamentation, we have ascribed this species to the genus *Articulina*.

As regards the ornamentation, fig.5*b* shows it under high power. The test is slightly constricted between the chambers. Each chamber bears a series of longitudinal ridges, and in each space between these there are two rows of minute tubercles.

Length 0·57 mm.

Remarks.—About 30 % of the material under examination was made up of foraminifera, the rest being composed of coral remains, polyzoa, coralline algæ, ostracods, and sponge spicules. The ostracods are particularly well represented, both in species and numbers. Glauconite casts are very rare. Miliolidæ and Nummulinidæ constitute the main bulk of the foraminifera present.

The occurrence of *Ophthalmidium cornu* and *Spiroloculina tortuosa* in considerable numbers is interesting inasmuch as these are new species described by Mr. F. Chapman in his report on the "Foraminifera from the Lagoon at Funafuti."* *Polystomella hedleyi* is very abundant and characteristic.

Bolivina is fairly well represented; other Textulariidæ, excepting *Verneuilina*, are extremely rare.

Operculina ammonoides is a very abundant form.

On the whole, the material is typical of coral reef conditions. Globigerinidæ and Lagenidæ are very rare.

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* Journ. Linn. Soc. Lond. Zoology. Vol. xxviii.

3. *Fine Foraminiferal Sand dredged at a depth of 300 fathoms, 27½ miles east of Sydney Heads, by Mr. C. Hedley.*

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Miliolina cultrata Brady.
2. Spiroloculina fragilissima Brady.
3. S. grata Terq.
4. S. impressa Terq.
5. S. excavata d'Orb.
6. S. limbata d'Orb.
7. S. nitida d'Orb.

Subfamily HAUERININÆ.

8. Cerviciferina hilli, sp.n. (Plate vi., figs. 7*a*, *b*).
9. Planispirina exigua Brady.

Subfamily PENEROPLIDINÆ.

10. Cornuspira carinata Costa.
11. C. involvens Reuss.

Family ASTRORHIZIDÆ.

Subfamily RHABDAMMININÆ.

12. Marsipella cylindrica Brady.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

13. Textularia concava Karrer.
14. T. quadrilateralis Schwager.
15. Spiroplecta americana Ehrenb.

Subfamily BULIMININÆ.

16. Bulimina aculeata d'Orb.
17. Virgulina subsquamosa Egger.
18. Bolivina punctata d'Orb.

Subfamily CASSIDULININÆ.

19. Cassidulina crassa d'Orb.

Family CHEILOSTOMELLIDÆ.

20. Cheilostomella ovoidea Reuss.
21. Allomorphina trigonula Reuss.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

22. Lagena sulcata W. & J.
23. L. sulcata var. interrupta Williamson (apiculate and non-apiculate forms).
24. L. hispida Reuss.
25. L. striata d'Orb.
26. L. orbignyana Seg.
27. L. globosa Montagu, var. grandipora, var.n. (Plate vi., fig. 10).

Subfamily NODOSARIINÆ.

28. Nodosaria communis d'Orb.
29. N. costulata Reuss.
30. N. inflexa Reuss.
31. N. scalaris Batsch (apiculate and nonapiculate, striated and nonstriated forms).
32. N. simplex Silv.
33. Lingulina carinata d'Orb.
34. Cristellaria sp.
35. C. calcar Linn. (nonspinous variety).
36. C. variabilis Reuss.
37. Cristellaria sp.; a young form intermediate between *C. crepidula* and *C. tricarinella.*
38. Cristellaria haswelli Goddard, Records of the Australian Museum, Vol. vi., Part 4.
39. Vaginulina sp.
40. Rhabdogonium tricarinatum d'Orb.

Subfamily POLYMORPHININÆ.

41. Uvigerina canariensis d'Orb.
42. U. interrupta Brady.
43. U. schwageri Brady.

44. Sagrina columellaris Brady.
45. S. sydneyensis, nov.sp. (Plate vi., figs. 4*a*, *b*, *c*).

Family GLOBIGERINIDÆ.

46. Globigerina bulloides d'Orb.
47. G. bulloides var. triloba Reuss.
48. G. dubia Egger.
49. G. æquilateralis Brady.
50. G. sacculifera Brady.
51. Orbulina universa d'Orb.
52. O. porosa Terq.
53. Pullenia obliquiloculata P. & J.
54. Hastigerina pelagica d'Orb.

Family ROTALIIDÆ.

Subfamily SPIRILLININÆ.

55. Spirillina vivipara Ehrenb.

Subfamily ROTALIINÆ.

56. Discorbina araucana d'Orb.
57. D. bertheloti d'Orb.
58. D. biconcava P. & J.
59. D. orbicularis Terq.
60. D. parisiensis d'Orb.
61. D. saulcii d'Orb.
62. D. valvulata d'Orb.
63. D. vilardeboana d'Orb.
64. Truncatulina haidingerii d'Orb.
65. T. præcincta Karrer.
66. T. wuellerstorfii Schwager.
67. T. tenuimargo Brady.
68. Anomalina ariminensis d'Orb.
69. A. ammonoides Reuss.
70. A. grosserugosa Gümb.
71. Pulvinulina haueri d'Orb.
72. P. menardii d'Orb.

73. P. MICHELINIANA d'Orb.
74. P. PAUPERATA P. & J.
75. P. PROCERA Brady.
76. P. CANARIENSIS d'Orb.
77. P. CRASSA d'Orb.
78. P. EXIGUA Brady.
79. ROTALIA PAPILLOSA Brady, var. COMPRESSIUSCULA Brady, C.R. pl.cviii.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

80. NONIONINA BOUEANA Reuss.
81. N. DEPRESSULA W. & J.
82. N. POMPILIOIDES F. & M.
83. N. SCAPHA F. & M.

SAGRINA SYDNEYENSIS, n.sp. (Plate vi., figs.4*a*, *b*).

This species has a straight cylindrical test. The commencement is a large hemispherical chamber which, however, contains one septum, indicating a uvigerine commencement. The subsequent chambers are short and cylindrical, and do not at first increase in diameter. Subsequently they increase slowly in diameter as well as in length (fig.4*a*). The surface of each chamber is ornamented with minute spines, and two or three extraordinarily large oval pores. The latter are irregularly distributed, but are chiefly found towards the proximal end of each segment. Size: length 0·57 mm.

CERVICIFERINA HILLI gen. et sp.nov. (Plate vi., figs.7*a*, *b*).

This remarkable form is circular in outline, and very depressed, nevertheless slightly biconvex, and surrounded by an equatorial keel (fig.7*a*). The initial chamber in the specimen figured is distinctly oval in outline and has an entosolenian neck. The succeeding chamber envelops the one first formed, and is distinctly flask-shaped. After this the chambers become more and more rounded, and the distal end of the one chamber is at the

proximal end of the next (see fig.7*a*). The shell is porcellanous and imperforate. It is surrounded by a keel having a peculiar terminal appendage.

The genus is most closely allied to the genera *Ophthalmidium* and *Hauerina*, from which it is distinguished by the characteristic generic features that the chambers have no trace of spiral commencement but are arranged in an alternating manner, and each chamber possesses a well marked neck. Diam. 0·38 mm.

Cristellaria variabilis Reuss, var. (Plate vi., fig.8).

The variety figured is sufficiently near the type to be assigned to that species. The figure shows the irregular arrangement of the chambers and the possession of a keel.

Cristellaria sp., intermediate between *C. lata* and *C. crepidula* (Fichtel & Moll). (Plate vi., fig.9).

The specimen is a very flattened minute form which has the arrangement of chambers of *C. crepidula* (Challenger Report, pl.67, fig.19).

Cristellaria haswelli Goddard, var. (Plate vi., fig.6).

This form so closely approaches *C. Haswelli* in general contour, size and arrangement of the chambers that there seems no necessity to give it a separate varietal name. As varietal distinctions between this form and the type, we might mention that the septal line shows but the faintest trace of a recurving; also the front peripheral margin of the shell has a wavy contour unlike the even outline of the type. The shell is also broader than in the type-form (Records of the Australian Museum, Vol. vi., Part iv.).

Lagena globosa Montagu, var. grandipora, var.nov. (Plate vi., fig.10).

This form has the entosolenian neck and ovoid shape of *L. globosa*, and differs only from the type in possessing a number (about 8) of irregularly distributed large pores.

The forms represented in this list overlap to a great extent those dredged by H.M.C.S. "Miner" 22 miles east of Sydney

Heads, at a depth of 80 fathoms, and described by one of us (E. J. G.) in the Records of the Australian Museum (Vol. vi., Part iv.). They also show considerable affinity to those dredged at a depth of 100 fathoms, 16 miles east of Wollongong. The similarity is striking in connection with the *Globigerinidæ*, *Discorbina* and *Pulvinulina*, which are very abundant in all these dredgings. The Wollongong material, however, differs from the other materials in the abundance of arenaceous and semi-arenaceous foraminifera.

Truncatulina praecincta, which is characteristic of warm waters and occurs on our coasts in all localities north of Sydney, is present in these dredgings, but is absent in the shallower water off Wollongong. The differences between the material dredged off Wollongong and off Sydney Heads is probably to be ascribed to the different nature of the bottom in the two places. Off Wollongong the bottom is largely basaltic, and off Sydney it is sandstone.

In the Sydney Heads material about 70 % is foraminiferal. Glauconitic casts are fairly abundant, but not to the same extent as in the Wollongong material. The foreign material consists of fragments of gastropod shells, pteropod shells, ostracods, spicules, and polyzoa.

The Mollusca from 300 fathoms off Sydney Heads have been described by Mr. C. Hedley in the Records of the Australian Museum (Vol. vi., Part 3).

4. *Foraminifera from Lyell Bay, New Zealand, collected on the beach by Mr. A. Hamilton.*

The material consists chiefly of gastropod shells, lamellibranch shells, polyzoa and coralline algæ. The following foraminifera were noticed :—

Family ASTRORHIZIDÆ.

Subfamily **RHABDAMMININÆ.**

1. Brachysiphon corbuliformis Chapman, Trans. N. Z. Inst. xxxviii. 1905, pl. iii., figs 2*a*, 2*b*, 3.
2. Aschemonella catenata Norman.

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

3. Discorbina vesicularis Lamk.
4. D. rugosa d'Orb.
5. Truncatulina rosea d'Orb.; rare.

Only a few specimens of *Brachysiphon corbuliformis* and *Aschemonella catenata* were obtained. *Brachysiphon* is a new genus described by Chapman in his paper on the Foraminifera and Ostracoda obtained off Great Barrier Island, New Zealand.

Discorbina vesicularis is the most plentiful form.

5. *Foraminifera obtained in shore (shell) sands at Kelso on the north coast of Tasmania.*

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Biloculina ringens Lamk.
2. B. depressa d'Orb. var.
3. Miliolina circularis Bornem.
4. M. seminulum Linn.
5. M. tricarinata d'Orb.
6. M. trigonula Lamk.
7. M. bicornis W. & J., var.nov.

Family LAGENIDÆ.

Subfamily POLYMORPHININÆ.

8. Polymorphina rotundata Bornem.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

9. Clavulina parisiensis d'Orb. (Plate vi., fig.11).

Family ROTALIIDÆ.

Subfamily ROTALIINÆ.

10. Discorbina rosacea d'Orb.
11. D. vesicularis Lamk.
12. Carpenteria proteiformis Goës.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

13. Polystomella imperatrix Brady.

This material was submitted to us by Miss M. Lodder. Accompanying the foraminifera there are several species of polyzoa.

The Miliolina which we have referred to *M. bicornis* is a new variety which has the striations and ornamentation of *M. pulchella* but the outline, aperture, and tooth of *M. bicornis*. The tooth, however, is rather more slender than that of typical *M. bicornis*.

Discorbina rosacea and *D. vesicularis* are the most abundant forms in the material, and they attain greater dimensions and more perfect development than those found in the Lyell Bay material, and other foraminiferal sands which we have examined.

It might be remarked that *Discorbina vesicularis* appears to thrive best in shallow water of the south temperate zone, especially where the waters are cold, as in Bass Strait where we have the Antarctic drift entering from the south-west.

Although specimens of this species occur in Port Jackson, they do not attain the grand development which they exhibit in Bass Strait. No doubt it will be found in increasing abundance south of Sydney, as we approach the cold current entering the Pacific Ocean through Bass Strait.

6. *Fossil Foraminifera kindly submitted by Miss M. Lodder, of the Launceston Museum.*

This material was obtained from the débris of fossil mollusca collected at Table Cape.

Family MILIOLIDÆ.

Subfamily MILIOLININÆ.

1. Biloculina sphæra d'Orb.
2. B. irregularis d'Orb.
3. B. elongata d'Orb.
4. B. ringens Lamk.

5. Miliolina alveoliniformis Brady.
6. M. bucculenta Brady.
7. M. circularis Bornem.
8. M. ferussacii d'Orb.
9. M. linnæana d'Orb.; only one specimen with small neck.
10. M. rupertiana Brady.
11. M. separans Brady.
12. M. seminulum Linn.
13. M. trigonula Lamk.
14. M. tricarinata d'Orb.
15. Spiroloculina limbata d'Orb.
16. S. acutimargo Brady.
17. S. fragilissima Brady.
18. S. tenuiseptata Brady.
19. S. tenuis Czjzek.
20. S. antillarum d'Orb.
21. S. nitida d'Orb.
22. S. planulata Lamk.

Subfamily **HAUERININÆ.**

23. Planispirina celata Costa.
24. P. contraria d'Orb.
25. P. exigua Brady.
26. P. (Sigmoilina) sigmoidea Brady.
27. Ophthalmidium inconstans Brady.

Subfamily **PENEROPLIDINÆ.**[1]

28. Cornuspira carinata Costa.
29. C. foliacea Phil.
30. C. involvens Reuss.

Family ASTRORHIZIDÆ.

Subfamily **ASTRORHIZINÆ.**

31. Astrorhiza crassatina Brady.

Subfamily **RHABDAMMININÆ.**

32. Hyperammina subnodosa Brady.

Family LITUOLIDÆ.

Subfamily LITUOLINÆ.

33. Reophax scorpiurus Montf.
34. R. loddereæ, n.sp.
35. Haplophragmium emaciatum Brady.
36. H. meridionale Chapman. (Plate vi., fig. 12).

Subfamily TROCHAMMININÆ.

37. Thurammina compressa Brady (?).
38. T. papillata Brady.

Subfamily LOFTUSIINÆ.

39. Cyclammina (?) cancellata (?) Brady.

Family TEXTULARIIDÆ.

Subfamily TEXTULARIINÆ.

40. Textularia sp.

Subfamily BULIMININÆ.

41. Bulimina pyrula d'Orb.
42. Virgulina subsquamosa Egger.

Subfamily CASSIDULININÆ.

43. Cassidulina subglobosa Brady.
44. C. parkeriana Brady.

Family CHEILOSTOMELLIDÆ.

45. Cheilostomella ovoidea Reuss.

Family LAGENIDÆ.

Subfamily LAGENINÆ.

46. Lagena sulcata W. & J.
47. L. aspera Reuss.
48. L. favosopunctata Brady.
49. L. trigonomarginata P. & J.
50. Lagena sp.

Subfamily NODOSARIINÆ.

51. Nodosaria roemeri Neugeb.
52. N. soluta Reuss.

53. N. ROEMERI Reuss, var. SEMICOSTATA, n.var. (Plate vi., fig. 14).
54. N. FILIFORMIS d'Orb.
55. N. OBLIQUA Linn
56. RHABDOGONIUM TRICARINATUM d'Orb.
57. FRONDICULARIA TRIMORPHA, n.sp. (Plate vi., fig. 13).

Subfamily **POLYMORPHININÆ.**

58. POLYMORPHINA ELEGANTISSIMA P. & J.
59. P. COMMUNIS d'Orb.
60. P. SORORIA Reuss.
61. P. COMPRESSA d'Orb.
62. P. ROTUNDATA Bornem.
63. P. LANCEOLATA Reuss.
64. P. REGINA B.P. & J.
65. SAGRINA RAPHANUS P. & J.

Family GLOBIGERINIDÆ.

66. GLOBIGERINA LINNÆANA d'Orb.
67. G. CRETACEA d'Orb.
68. ORBULINA UNIVERSA d'Orb.

Family ROTALIIDÆ.

Subfamily **ROTALIINÆ.**

69. DISCORBINA TURBO d'Orb.
70. D. BERTHELOTI d'Orb.
71. D. GLOBULARIS d'Orb.
72. D. PARISIENSIS d'Orb.
73. D. RUGOSA d'Orb.
74. D. VILARDEBOANA d'Orb.
75. TRUNCATULINA HAIDINGERII d'Orb.
76. T. LOBATULA W. & J.
77. T. REFULGENS Montf.
78. T. ROSTRATA Brady.
79. T. ROSEA d'Orb.
80. T. UNGERIANA d'Orb.
81. T. WUELLERSTORFII Schwag.

82. Anomalina ammonoides Reuss.
83. A. grosserugosa Gümb.
84. Planorbulina larvata P. & J.
85. P. acervalis Brady.
86. Pulvinulina carpenteri Reuss (Chapman, Journ. Roy. Micr. Soc. 1898, p.8, pl. i., figs.11*a-c*).
87. P. elegans d'Orb.
88. P. favus Brady.
89. P. menardii d'Orb.
90. P. canariensis d'Orb.
91. P. tumida Brady.
92. Cymbalopora (?) poeyi d'Orb. (?)
93. Rotalia beccarii Linn.
94. R. orbicularis d'Orb.
95. R. soldanii d'Orb.

Family NUMMULINIDÆ.

Subfamily POLYSTOMELLINÆ.

96. Nonionina boueana d'Orb.
97. N. pompilioides F. & M.
98. N. depressula W. & J.
99. Polystomella craticulata F. & M.
100. P. macella F. & M.
101. P. striatopunctata F. & M.
102. P. subnodosa Münst.
103. P. verriculata Brady.

Subfamily CYCLOCLYPEINÆ.

104. Cycloclypeus sp.

New Species and Varieties.

Haplophragmium meridionale (?) Chapman, var.

Only one specimen of this species was obtained. The test was thin, diaphanous and subelliptical, but the sutures were not well marked. We refer it to Mr. Chapman's new species on account of its resemblance to the shell figured by him in Ann. S. Afr. Mus. Vol. iv., pl. xxix., fig.2.

FRONDICULARIA TRIMORPHA, n.sp. (Plate vi., fig.13).

This species, as shown in fig.13, has the earlier chambers arranged as in the genus *Cristellaria*; three or four chambers arranged as in *Frondicularia inæqualis* follow, and the final chambers are irregularly disposed as in *Polymorphina*. Size: length 1·38 mm.

NODOSARIA ROEMERI Neugeboren, var. SEMICOSTATA, var.nov. (Plate vi., fig.14).

This varietal form has the shape, size, and aperture of the type, but the earlier chambers bear well marked longitudinal costæ which have a tendency to run spirally round the shell. This character links the variety to *Nodosaria prismatica* (Reuss). Size: length 4 mm.

REOPHAX LODDERÆ, sp.n. (Plate vi., fig.15).

This is a large form consisting of a linear series of chambers whose tests are composed of sand grains and spicules. The spicules are large, derived from echinoids, and are placed with the greatest regularity, one row corresponding to each chamber of the test, and overlapping the row belonging to the next chamber. Length (incomplete); diameter 0·75 mm.

The Table Cape material was forwarded to one of us (H. I. J.) by Miss M. Lodder, an Associate Member of this Society, and Honorary Curator of the Launceston Museum. She has very kindly also supplied us with particulars how the material was collected. She writes as follows:—"I collected the specimens (foraminifera) from the débris of the matrix (molluscan shells), as well as from the inside of a large number of shells collected by various people from the Tertiary beds at Table Cape." The mollusca include Terebra, Voluta, Bela, Ancilla, Marginella, Typhis, Murex, Cypræa, Natica, Lima, Pecten, Arca, Cucullæa, Glycimeris, Cardita, Crassatellites, Chione, Solenocurtius, Tellina, &c.

Miss Lodder believes that most of the above fossils were taken from the sea-side, or broken face, of Table Cape.

In response to an enquiry made by the authors as to the supposed age of the beds from which the fossils were taken, Miss Lodder has kindly furnished the following information:—"I can only quote the words of Mr. J. Dennant and Mr. A. E. Kitson in their Catalogue of the 'Described Species of Fossils (except Bryozoa and Foraminifera) in the Cainozoic Fauna of Victoria, S. Australia, and Tasmania,' published in the Records of the Geological Survey of Victoria (Vol. i. pt.2, 1903, p.189).

"'Group C. records the fossils belonging to the Table Cape and Spring Creek Deposits. By Tate they have been named Post-Eocene (Oligocene?), while by Messrs. Hall and Pritchard they are placed on a lower horizon than the distinctly Eocene Mornington Beds. Their separate grouping in this catalogue of species is intended to imply that no opinion is expressed concerning the relative age of the beds in question. Those interested in the matter should consult original memoirs.'"

In the Proceedings of the Royal Society of Victoria, Vol. viii. (New Series) Mr. G. B. Pritchard publishes "A Revision of the Fossil Fauna of the Table Cape Beds, Tasmania, with Descriptions of New Species" His inferences regarding the age of the beds are almost identical with our conclusions from a study of the Foraminifera.

The Foraminifera contained in the Table Bay material have a decidedly Eocene or Palæogene character, agreeing closely with those enumerated for the Eocene by Howchin.*

The occurrence of forms answering to the description of *Pulvinulina carpenteri* and *Haplophragmium meridionale* figured by Chapman in his account of the foraminifera of Pondoland West† serves as corroborative evidence of the old-Tertiary age of the material.

Nodosaria zippei and *Rotalia soldanii* occur here as well as in Mr. Chapman's Pondoland material which, however, is Cretaceous.

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* Report Aust. Assoc. Adv. Sc. Vol. v. Adelaide, S.A., 1893.

† Ann. South African Mus. Vol. iv. Part v.

Numerous ostracods having the appearance of forms figured by Chapman in the above-mentioned report were observed in the material.

In general it may be stated that the richness of the foraminiferal fauna is indicative of warm water conditions of deposition. Further, it is certain that the material was laid down at a depth of from 50 to 150 fathoms. These conclusions are based on the occurrence of forms which are restricted to warm zones and shallow water, and to the complete absence of cold-water forms such as *Discorbina vesicularis* which now flourishes in the same latitude.

There is a close correspondence between the Miliolidæ of the Table Cape fossil material and recent dredgings from Sydney Heads and Byron Bay. The Table Cape fossil Nodosariinæ correspond closely with Howchin's Eocene list and those occurring at Byron Bay. The abundance of Polymorphininæ indicates deposition in shallow water (less than 200 fathoms). The abundance of Polystomellinæ, and especially so of species which do not occur at Sydney or Byron Bay now, but are restricted to strictly tropical waters, as at Torres Strait and the Barrier Reef, is itself conclusive evidence of warm-water conditions at the time of deposition.

Certain species found in the Table Cape fossil material deserve special mention in support of these statements; they are :—

(a) *Biloculina irregularis* is a tropical species, which has only been observed by us elsewhere in the Gulf of Carpentaria material.

(b) *Miliolina alveoliniformis* is a coral-reef species confined to shallow water. Occurs also in the Gulf of Carpentaria.

(c) *Miliolina rupertiana* occurs only in shallow water in warm latitudes.

(d) *Spiroloculina antillarum* is a common form off the coast of Brazil.

(e) *Spiroloculina planulata* and *S. nitida* are closely allied species, the former being characteristic of temperate zones, the latter replacing it in the tropical zone. Both are shallow water forms, and both occur at Table Cape.

[The Miliolidæ in general flourish best in tropical seas, from the shore to depths of 150 fathoms; and this family is exceedingly well represented].

(f) *Cassidulina parkeriana* is characteristic of tropical seas at depths of 45-175 fathoms.

(g) *Lagena favosopunctata* is, according to the Challenger Report, restricted to the shores of New Guinea and Torres Strait at a depth of 17 to 155 fathoms.

(h) *Polymorphina regina* is a shallow water form occurring round the islands of the Pacific, to be found in Howchin's list of Eocene foraminifera, but not in later Tertiary Australian deposits.

(i) The Rotaliidæ of our Table Cape material exhibit a striking parallelism to the forms now occurring off Sydney Heads and Byron Bay, especially as regards Truncatulina. Discorbina is not an abundant form, and the species present are forms which thrive best in warm latitudes.

From a study of this material, the conclusion is unavoidable that the material was deposited in Eocene times in a shallow sea; and, furthermore, that in this period climatic conditions were much warmer in the Tasman region than now.

In conclusion it is necessary to mention that our attention has been drawn by Mr. F. Chapman, F.R.M.S., to the fact that recent forms resembling *Biloculina ringens* and *B. bulloides* are referred to other genera on account of their internal structure differing from the fossil forms for which the above-mentioned names have been retained.* We have however not sectioned any of the forms of Miliolidæ enumerated in our lists, and have therefore retained the well-known names of *Biloculina ringens* and *B bulloides;* the retention of these names in our paper has the advantage of making these lists consistent with other lists of Australian Foraminifera such as Whitelegge's list in "Invertebrate Fauna of Port Jackson and Neighbourhood," †

* Schlumberger, Mém. Soc. Zool. France. Vol. iv. 1891.

† Journ. Proc. Roy. Soc. N.S. Wales. Vol. xxiii. 1889.

Howchin's "Census of the Fossil Foraminifera of Australia,"* and our own previously published notes, as well as with the Challenger Report and Flint's "Recent Foraminifera."

We are also indebted to Mr. F. Chapman for pointing out to one of us that *Miliolina bucculenta* in this and in our previous papers should read *Planispirina bucculenta*. *Biloculina sphæra* d'Orbigny, should likewise read *Planispirina sphæra;* and *Planispirina sigmoidea* should read *Sigmoilina sigmoidea*. We retain the commoner names for the sake of consistency and because we have not had access to the papers in which the proposed changes and the reasons for them are given.

In his "Notes on Prosobranchiata No. i.,"† discussing Australian fossil species of the genus Lotorium, Mr. H. L. Kesteven remarks:—"*Lotorium parkinsonianum* is the recent representative of *L. radiale*, *abbotti*, *textile*, *woodsii*, and *tortirostris*." A glance at Dennant's "Catalogue of the Described Species of Fossils,"‡ shows that three of these species, namely, *Lotorium (Lampusia) abbotti*, *woodsii*, and *tortirostris* occur at Table Cape.

On p. 455 of the same paper Mr. Kesteven goes on to say:—"Thus, if we compare this genus (Lotorium) as it occurs in the Lower Australian strata with European Miocene representatives, we are presented with two entirely different types of the genus. The predominating feature of the Australian section—that of the extinct Antarctic group—finds expression in only one European fossil *(L. tarbellianum)*. Again, if the two groups be compared with the recent representatives it will be seen that the European section has the general facies of recent species, whilst the Australian fossils can, with one exception, be only compared *inter se*. . . . . These facts . . . . assuredly point to the greater antiquity of the Australian fossils."

From the large number of specimens which had their apices complete (over 70 per cent.) Mr. Kesteven infers (*op. cit.* p. 465) that the beds were deposited below the tidal limit.

* Report Aust. Assoc. Adv. Sc. Vol. v. Adelaide, 1893.
† Proc. Linn. Soc. N.S.Wales, 1902, p. 454.
‡ Records Geol. Surv. Victoria, Vol. i, Part 2, p. 107.

It is very interesting to notice that our conclusions as regards the age of the deposits, and the depth at which they were laid down, agree so closely with those of Mr. Kesteven based on a study of the mollusca.

EXPLANATION OF PLATE VI.

Fig.1.—*Textularia quadrilatera* var.(×90).
Fig.2.—*Cristellaria variabilis* var. *allomorphinoides*, n.var.(×90).
Fig.3*a*.—*Sagrina australiensis* n.sp.(×90).
Fig.3*b*.—*Sagrina australiensis*, n.sp., showing appearance by transmitted light under higher power.
Fig.3*c*.—*Sagrina australiensis*, n.sp., showing tubules in walls.
Fig.4.—*Sagrina sydneyensis*, n.sp.(×90).
Fig.4*b*.—*Sagrina sydneyensis*, n.sp., showing pores and structure of wall.
Fig.5*a*.—*Articulina chapmani*, n.sp.(×90).
Fig.5*b*.—*Articulina chapmani*, n.sp., showing ornamentation under higher power.
Fig.6.—*Cristellaria haswelli* var.(×90).
Fig.7*a*.—*Cerviciferina hilli*, n.sp.; seen by reflected light (×90).
Fig.7*b*.—*Cerviciferina hilli*, n.sp.; seen by transmitted light (×90).
Fig.8.—*Cristellaria variabilis* var.(×90).
Fig.9.—*Cristellaria* sp., intermediate between *C. lata* and *C. crepidula* (×90).
Fig.10.—*Lagena globosa* var. *grandipora*, n.var.(×90).
Fig.11.—*Clavulina parisiensis* (×30).
Fig.12.—*Haplophragmium meridionale* var.(×30).
Fig.13.—*Frondicularia trimorpha*, n.sp.; seen by transmitted light (×30).
Fig.14.—*Nodosaria roemeri* var. *costata*, n.var. (×30).
Fig.15.—*Reophax loddera*, n.sp.(×30).